REMARKS

Claims 25-39 are rejected in the Final Office Action of April 20, 2004. Applicants offer Amendments to claim 25 and 32 with this after final amendment, and respectfully request their entry. Upon entry the amendments Claims 25-39 remain pending.

Support for the amendments is found in the application as filed, for example in the specification and figures as discussed below. Applicants respectfully request entry of the amendments.

REJECTION UNDER 35 U.S.C. § 102 OVER THE DASH REFERENCE

Claims 25, 29, 30, 31, 32, and 39 are rejected under 35 U.S.C. § 102(b) as anticipated by the Dash reference, U.S. Patent No. 2,491,479. Applicants respectfully traverse the rejection and request reconsideration in light of the Amended claims.

In previous prosecution, Applicants have amended claims 25 and 32 to recite that the surface of the stud to be welded or the stud head has a layer of a titanium containing material in at least a portion or a surface of the head (claim 25) or that it has a layer of a titanium containing material (claim 32). The amendments to claims 25 and 32 were made in response to earlier rejections over the Dash reference.

In the latest Office Action, the Examiner concedes that the Dash reference does not disclose a layer as recited in the claims (i.e. a separate layer as discussed below), but takes the position that the claims are to be given their broadest reasonable interpretation. The Examiner takes the position that since the entire stud of the Dash reference is made of a titanium-containing aluminum alloy, there would inherently be a layer at the surfaces containing the same material. The Examiner concludes that Dash continues to read on the offered claims.

In the interest of advancing prosecution, Applicants respectfully offer amendments to claims 25 and 32 that further distinguish the claims over the disclosure of the Dash reference. Specifically, Applicants have amended claim 25 and 32 to recite that the stud head or the surface of the stud to be welded has or is provided with a <u>separate layer</u> of a titanium containing material that is <u>different</u> from the material in the surface of the stud or in the stud head. Support for the amendment is found as discussed below.

Attention is respectfully drawn to page 6, line 15 of the specification;

> "...ALODINE® 2040 causes a relative thin and uniform thickness layer of titanium aluminum oxide crystals to be <u>formed on the surface</u> of the weld-on part."

Further on page 7, line 10, the specification states, in describing Figure 2 that

> "the welding face (4) is <u>provided with</u> a layer (5) of a titanium containing material."

Still further, the abstract states that a stud

> "has a surface that is at least partially <u>provided with a layer</u> (5) which contains a titanium containing material. The stud (1) is treated...causing a layer (5) of titanium containing material to be formed on at least a portion of the stud (1)."

All three passages recite processes by which a recognizable separate layer made of a different material than that of the stud body or surface is formed on the stud. The layer is formed on the surface or the layer is provided on the surface.

Figure 2 confirms the structure. Stud (1) has a welding head (3) with a welding face (4), and the welding face (4) is provided with a <u>layer</u> (5) of a titanium containing material. Figure 2 clearly shows a <u>separate</u> layer.

As recited in the amended claims, the titanium containing material forms a separate layer having a different composition on a surface of the stud. By amendments to claims 25 and 32,

Applicants intend to provide structure in the claim to differentiate the claimed structures from that disclosed in the Dash reference. As conceded by the Examiner, Dash does not disclose a separate layer.

For the reasons discussed above, Applicants believe that the amended claims are patentable in view of the Dash reference. Applicants further respectfully submit that substantive examination is not required, because the amendments are offered in the spirit of clarification and complying with an implicit Office Action directive that the claims should be amended to recite structure differentiating the claimed invention from the disclosure of the Dash reference. For this reason, Applicants believe entry after Final Rejection is permissible. Accordingly, Applicants respectfully request the Examiner enter the amendments and consider the above arguments for patentability.

REJECTION UNDER 35 U.S.C. § 103

Claims 26-28 and 33-38 are rejected under 35 U.S.C. § 103(a) as being unpatentable over the Dash reference as applied to claims 25 and 32 and further in view of either the Martin (U.S. Pat. No. 2,670,424) reference or the Konnert (U.S. Pat. No. 4,326,894) reference. In light of the current amendments and for the reasons given in Applicants' reply of January 28, 2004, Applicants respectfully traverse the rejections as applied to the amended claims and request reconsideration.

By their dependence from Amended claims 25 and 32, all of the rejected claims contain the limitation recited above, i.e. that the weld stud contains a separate layer of titanium containing material different from the material of the stud head. Applicants respectfully submit that the Dash reference is no longer applicable to amended claims 25 and 32. As a result, Applicants further respectfully submit that the secondary references fail to make up for the

deficiencies, so that the inventions recited in the amended claims are non-obvious in light of the cited references. Accordingly, Applicants respectfully request that the rejections under Section § 103 as applied to the amended claims be withdrawn.

Just because references can be combined to arrive at the claimed subject matter to support a rejection, such combination is not obvious unless there is a suggestion that the combination would be desirable. In assessing the teaching of cited references, it is appropriate to consider the entire teaching of the references and the interpretation a person of skill in the art would apply to those teachings. In particular, portions of the reference that teach away from making the combination should be considered in determining whether the invention as a whole would have been obvious to a person of skill in the art.

As noted above, the Dash reference discloses an aluminum stud, but it does not teach a coating of titanium on the stud, as recited by the amended claims 25 and 32. Accordingly, these and other features of claims 26-28 and 33-38 must be supplied by combining Dash with the cited references Martin and Konnert.

The Martin reference teaches away from coating an aluminum stud with titanium. Martin is drawn to the welding of steel or steel alloy studs to plates made of steel. Column 1, line 12-14. Aluminum is preferred for metallizing a steel stud, but other alloys having the required characteristics may be used depending on the material the stud is made of. Column 3, lines 9-13. The required characteristics include that the metal for metallizing the (steel) surface of the stud have a higher conductivity than the stud material. Column 2, lines 42-45.

In the current claims, on the other hand, the metal (titanium) forming a coating on the studs has a lower conductivity than the stud metal (aluminum). Thus, while Martin teaches aluminum is preferred to put on an iron or steel stud, it specifically teaches away from using a

poorly conductive metal, such as titanium, to coat a highly conductive material such as aluminum.

The Office Action appears to acknowledge the appropriateness of this line of reasoning, but declines to apply it to remove the claim rejections. Applicants now address two main points made by the Examiner in characterizing the teachings of the secondary reference Martin.

First, the Examiner directs attention to the last three paragraphs of the Martin reference, where "it [is] discussed [that] the grain of the metal, protection against corrosion by atmospheric or climatic conditions, and nitrogenous contamination all apparently influence the weld stud". The Examiner seems to take the position that, despite its teachings elsewhere that the metal applied to the stud must be of a higher conductivity, the reference taken as a whole nevertheless suggests the desirability of applying Ti (conductivity 5) onto Al (conductivity 39-59). Commenting on the passage, the Examiner states that weld studs are ultimately more complex than simply the conductivity of the metals and concludes a titanium layer "would have been recognized to ultimately provide an improved weld stud even on aluminum".

Applicants respectfully submit the cited passage reinforces the teachings that a deposited metal must be of a higher conductivity than the stud material. The passage more fully quoted in context is illustrative:

> "The metallization of the stud <u>in the manner hereinbefore described</u> has desirable effects in that, for example, the grain of the metal at the weld junction is improved and strength and toughness of the metal of the weld are increased.
>
> The fact that the metallizing material is intimately bonded or united to the metal of the stud ensures the protection of the welding and of the stud against corrosion by atmospheric or climatic conditions ... "

Col. 4, lines 45-54, emphasis added. The passage states that the advantageous properties of the weld (grain, strength, toughness, protection from corrosion) are due to metallizing the stud <u>in the manner described</u>, i.e. by putting a metal of higher conductivity on the stud. Contrary to the

suggestion in the Office Action, a person of skill in the art would not understand the reference to suggest using Ti on Al, because Ti is of much lower conductivity.

Second, the Office Action states that a proposal to coat a steel stud with titanium would be counter to Martin's own objectives because the titanium is less conductive than the steel. Implicit is an assertion the reference when viewed as a whole would teach a person of skill in the art to provide a titanium coating on an aluminum stud, as recited in the claims.

The Examiner is correct to consider all the teachings of the reference in determining whether the invention would have been obvious. When different passages appear to be inconsistent or to suggest different results, it is appropriate to weigh the passages in question to determine what a skilled person would understand the teachings to be. Applicants respectfully submit that a proper weighing indicates that the proposal mentioned above does not outweigh or counter the explicit teachings elsewhere in Martin that the metallizing material be of a higher conductivity. For example, at column 2, lines 35*ff* the invention is described as metallizing the surface of the stud with a metal of higher conductivity. Furthermore, as previously noted, even the claims recite the higher conductivity limitation. Taken as a whole, the reference would not suggest to a skilled person to coat Al (conductivity 39-59) with Ti (conductivity 5).

In addition, a person of skill in the art knows that titanium is in fact more conductive than many steels. Because of this, it is not even clear that the second passage cited above by the Examiner is inconsistent or contradictory when read with the rest of the reference. The conductivity of Ti is about 5, while the conductivity of steel varies from 3 to 15 (based on Cu = 100), according to the attached AMM website page. The attached page 56 from Metals Handbook, 8th ed. vol. 1 shows comparative conductivity of aluminum and steel. Note that it shows pure copper is 103. On this scale, it is seen that various steel alloys range from 3 to 17.5.

Several different silicon steels, stainless steels, and nickel irons are listed with conductivity from 3 to 4, i.e. less than Ti with a value of about 5 on this scale. The Martin reference is silent as to what steel or alloy is contemplated when it proposes coating it with Ti. Because many steels are in fact less conductive than titanium, the passage is consistent with the rest of the reference that teaches metallizing with a higher conductivity metal.

CONCLUSION

For the reasons discussed above, Applicants believe that amended claims 25-39 are patentable over the cited references. Applicants respectfully request that the Examiner enter the amendments after final and consider the above arguments. Alternatively, Applicants request an Advisory Action stating whether favorable action is possible at this time. Applicants respectfully submit that the amended claims are in a state of allowance and respectfully request an early notice of such allowance. If the Examiner believes personal communication would expedite prosecution of this Application, the Examiner is invited to telephone the undersigned at 248-641-1600.

Respectfully submitted,

Dated: August 11, 2004

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Electrical Conductivity of Metals

This page is best viewed in Netscape 2.0+ or other table-capable browsers.
The table originally appeared in *AMM*'s annual *Metal Statistics* book.

Metal	Relative Conductivity*	Temperature Coefficient of Resistance**	Tensile Strength (lbs./sq. in.)	Composition of Earth's Crust (% by Weight)
Aluminum (2S; pure)	59	0.0039	30,000	8.1
Aluminum (alloys):				
• *Soft-annealed*	45-50	—	—	—
• *Heat-treated*	30-45	—	—	—
Brass	28	0.002-0.007	70,000	—
Cadmium	19	0.0038	—	.0001
Chromium	55	—	—	.02
Climax	1.83	0.0007	150,000	—
Cobalt	16.3	0.0033	—	.002
Constantin	3.24	0.00001	120,000	—
Copper:				
Hard drawn	89.5	0.00382	60,000	—
• *Annealed*	100	0.00393	30,000	.007
Everdur	6	—	—	—
Gold	65	0.0034	20,000	.0000005
Iron:				
• *Pure*	17.7	0.005	—	5.0
• *Cast*	2-12	—	—	—
• *Wrought*	11.4	—	—	—
Lead	7	0.0039	3,000	.002
Magnesium	—	0.004	33,000	2.1
Manganin	3.7	0.00001	150,000	—
Mercury	1.66	0.00089	0	.00005
Molybdenum	33.2	0.004	—	.001
Monel	4	0.002	160,000	—
Nichrome	1.45	0.0004	150,000	—
Nickel	12-16	0.006	120,000	.008
Nickel silver (18%)	5.3	0.00014	150,000	—
Phosphor bronze	36	0.0018	25,000	—
Platinum	15	0.003	55,000	.0000005
Silver	106	0.0038	42,000	.00001
Steel	3-15	0.004-0.005	42,000-230,000	—
Tin	13	0.0042	4,000	.004
Titanium	5	—	50,000	.4
Titanium, 6A14V	5	—	130,000	—
Tungsten	28.9	0.0045	500,000	.007
Zinc	28.2	0.0037	10,000	.01

** At 20° Celsius, based on copper as 100.*
*** Per degree C at 20° C.*
Note: The conductivity of various metals is subject to variation according to processing and alloy composition.

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Electrical Conductivity and Resistivity of Metals and Alloys

Aluminum and Aluminum Alloys

Material	Conductivity, % IACS	Resistivity, microhm-cm
Aluminum (99.996%)	64.94	2.65
EC (O and H19)	62	2.8
3052 (O and H38)	35	4.93
5056 (H38)	27	6.4
6101 (T6)	56	3.1

Copper and Copper Alloys

Material	Conductivity, % IACS	Resistivity, microhm-cm
Wrought Coppers		
Pure Copper	103.06	1.67
Electrolytic (ETP)	101	1.71
Oxygen-Free Copper (OF)	101	1.71
Free-Machining (0.5% Te)	95	1.82
Free-Machining (1.0% Pb)	98	1.76
Wrought Alloys		
Cartridge Brass, 70%	28	6.2
Yellow Brass	27	6.4
Leaded Commercial Bronze	42	4.1
Phosphor Bronze, 1.25%	48	3.6
Nickel Silver, 55-18	5.5	31
Low-Silicon Bronze (B)	12	14.3
Beryllium Copper	22 to 30(a)	5.7 to 7.8(a)
Casting Alloys		
Chromium Copper (1% Cr)	80 to 90(a)	2.10
88 Cu - 8 Sn - 4 Zn	11	15
87 Cu - 10 Sn - 1 Pb - 2 Zn	11	15

Electrical Contact Materials

Material	Conductivity, % IACS	Resistivity, microhm-cm
Copper Alloys		
0.04 oxide	100	1.72
1.25 Sn + P	48	3.6
5 Sn + P	18	11
8 Sn + P	13	13
15 Zn	37	4.7
20 Zn	32	5.4
35 Zn	27	6.4
2 Be + Ni or Co(b)	17 to 21	9.6 to 11.5
Silver and Silver Alloys		
Fine Silver	106	1.59
92.5 Ag - 7.5 Cu	85	2
90 Ag - 10 Cu	85	2
72 Ag - 28 Cu	87	2
72 Ag - 26 Cu - 2 Ni	60	2.9
85 Ag - 15 Cd	35	4.93
97 Ag - 3 Pt	50	3.5
97 Ag - 3 Pd	60	2.9
90 Ag - 10 Pd	30	5.3
90 Ag - 10 Au	40	4.2
60 Ag - 40 Pd	8	23
70 Ag - 30 Pd	12	14.3
Platinum and Platinum Alloys		
Platinum	16	10.6
95 Pt - 5 Ir	9	19
90 Pt - 10 Ir	7	25
85 Pt - 15 Ir	6	28.5
80 Pt - 20 Ir	5.6	31
75 Pt - 25 Ir	5.5	33
70 Pt - 30 Ir	5	35
65 Pt - 35 Ir	5	36
95 Pt - 5 Ru	5.5	31.5
90 Pt - 10 Ru	4	43
89 Pt - 11 Ru	4	43
86-Pt - 14 Ru	3.5	46
96 Pt - 4 W	5	36
Palladium and Palladium Alloys		
Palladium	16	10.8
95.5 Pd - 4.5 Ru	7	24.2
90 Pd - 10 Ru	6.5	27
70 Pd - 30 Ag	4.3	40
60 Pd - 40 Ag	4.0	43
50 Pd - 50 Ag	5.5	31.5
72 Pd - 26 Ag - 2 Ni	4	43
60 Pd - 40 Cu	5	35(c)
45 Pd - 30 Ag - 20 Au - 5 Pt	4.5	39
35 Pd - 30 Ag - 14 Cu - 10 Pt - 10 Au - 1 Zn	5	35
Gold and Gold Alloys		
Gold	75	2.35
90 Au - 10 Cu	16	10.8
75 Au - 25 Ag	16	10.8
72.5 Au - 14 Cu - 8.5 Pt - 4 Ag - 1 Zn	10	17
69 Au - 25 Ag - 6 Pt	11	15
41.7 Au - 32.5 Cu - [illegible] Ni - 7 Zn	4.5	39

Electrical Heating Alloys

Material	Conductivity, % IACS	Resistivity, microhm-cm
Ni-Cr and Ni-Cr-Fe Alloys		
78.5 Ni, 20 Cr, 1.5 Si (80-20)	1.6	108.05
73.5 Ni, 20 Cr, 5 Al, 1.5 Si	1.2	137.97
68 Ni, 20 Cr, 8.5 Fe, 2 Si	1.5	116.36
60 Ni, 16 Cr, 22.5 Fe, 1.5 Si	1.5	112.20
35 Ni, 20 Cr, 43.5 Fe, 1.5 Si	1.7	101.4
Fe-Cr-Al Alloys		
72 Fe, 23 Cr, 5 Al	1.3	138.8
55 Fe, 37.5 Cr, 7.5 Al	1.2	166.23
Pure Metals		
Molybdenum	34	5.2
Platinum	16	10.64
Tantalum	13.9	12.45
Tungsten	30	5.65
Nonmetallic Heating Element Materials		
Silicon Carbide, SiC	1 to 1.7	100 to 200
Molybdenum Disilicide, $MoSi_2$	4.5	37.24
Graphite	....	910.1

Instrument and Control Alloys

Material	Conductivity, % IACS	Resistivity, microhm-cm
Cu-Ni Alloys		
98 Cu - 2 Ni	35	4.99
94 Cu - 6 Ni	17	9.93
89 Cu - 11 Ni	11	14.96
78 Cu - 22 Ni	5.7	29.92
55 Cu - 45 Ni (constantan)	3.5	49.87
Cu-Mn-Ni Alloys		
87 Cu - 13 Mn (manganin)	3.5	48.21
83 Cu - 13 Mn - 4 Ni (manganin)	3.5	48.21
85 Cu - 10 Mn - 4 Ni (shunt manganin)	4.5	38.23
70 Cu - 20 Ni - 10 Mn	3.6	48.88
67 Cu - 5 Ni - 27 Mn	1.8	99.74
Ni-Base Alloys		
99.8 Ni	23	7.98
71 Ni - 29 Fe	9	19.95
80 Ni - 20 Cr	1.5	112.2
75 Ni - 20 Cr - 3 Al + Cu or Fe	1.3	132.98
76 Ni - 17 Cr - 4 Si - 3 Mn	1.3	132.98
60 Ni - 16 Cr - 24 Fe	1.5	112.2
35 Ni - 20 Cr - 45 Fe	1.7	101.4
Fe-Cr-Al Alloy		
72 Fe - 23 Cr - 5 Al - 0.5 Co	1.3	135.48
Pure Metals		
Iron (99.99%)	17.75	9.71
(See also *Electrical Heating Alloys*)		

Thermostat Metals

Material	Conductivity, % IACS	Resistivity, microhm-cm
75 Fe - 22 Ni - 3 Cr	3	78.13
72 Mn - 18 Cu - 10 Ni	1.5	112.2
67 Ni - 30 Cu - 1.4 Fe - 1 Mn	3.5	56.52
75 Fe - 22 Ni - 3 Cr	12	15.79
66.5 Fe - 22 Ni - 8.5 Cr	3.3	58.16

Permanent Magnet Materials

Material	Conductivity, % IACS	Resistivity, microhm-cm
Carbon steel (0.65% C)	9.5	18
Carbon steel (1% C)	8	20
Chromium steel (3.5% Cr)	6.1	29
Tungsten steel (6% W)	6	30
Cobalt steel (17% Co)	6.3	28
Cobalt steel (36% Co)	6.5	27
Intermediate Alloys		
Cunico	7.5	24
Cunife	9.5	18
Comol	3.6	45
Alnico Alloys		
Alnico I	3.3	75
Alnico II	3.3	65
Alnico III	3.3	60
Alnico IV	3.3	75
Alnico V	3.5	47
Alnico VI	3.5	50

Magnetically Soft Materials

Material	Conductivity, % IACS	Resistivity, microhm-cm
Electrical Steel Sheets		
M-50	9.5	18
M-43	6 to 9	20 to 28
M-36	5.5 to 7.5	24 to 33
M-27	3.5 to 5.5	33 to 47
M-22	3.5 to 5	41 to 52
M-19	3.5 to 5	41 to 56
M-17	3 to 3.5	45 to 58
M-15	3 to 3.5	45 to 69
M-14	3 to 3.5	50 to 69
M-7	3 to 3.5	45 to 52
M-6	3 to 3.5	45 to 52
M-5	3 to 3.5	45 to 52
Moderately-High-Permeability Materials(d)		
Thermenol	0.5	162
16 Alfenol	0.7	153
Sinimax	2	90
Monimax	2.5	80
Supermalloy	3	65
4-79 Moly Permalloy, Hymu 80	3	58
Mumetal	3	60
1040 alloy	3	56
High Permalloy 49, A-L 4750, Armco 48	3.6	48
45 Permalloy	3.6	45
High-Permeability Materials(e)		
Supermendur	4.5	40
2V Permendur	4.5	40
35% Co, 1% Cr	9	20
Ingot iron	17.5	10
0.5% Si steel	6	28
1.75% Si steel	4.6	37
3.0% Si steel	3.6	47
Grain-oriented 3.0% Si steel	3.5	50
Grain-oriented 50% Ni iron	3.6	45
50% Ni iron	3.5	50

Relay Steels and Alloys after Annealing

Material	Conductivity, % IACS	Resistivity, microhm-cm
Low-Carbon Iron and Steel		
Low-carbon iron	17.5	10
1010 steel	14.5	12
Silicon Steels		
1% Si	7.5	23
2.5% Si	4	41
3% Si	3.5	49
3% Si, grain-oriented	3.5	48
4% Si	3	59
Stainless Steels		
Type 410	3	57
Type 416	3	57
Type 430	3	60
Type 443	3	68
Type 446	3	61
Nickel Irons		
50% Ni	3.5	48
78% Ni	11	16
77% Ni (Cu, Cr)	3	60
79% Ni (Mo)	3	58

Stainless and Heat-Resisting Alloys

Material	Conductivity, % IACS	Resistivity, microhm-cm
Type 302	3	72
Type 309	2.5	78
Type 316	2.5	74
Type 317	2.5	74
Type 347	2.5	73
Type 403	3	57
Type 405	3	60
Type 501	4.5	40
HH	2.5	80
HK	2	90
HT	1.7	100

(a) Precipitation hardened; depends on processing. (b) A heat treatable alloy. (c) Annealed and quenched. (d) At low field strength and high electrical resistance. (e) At higher field strength; annealed for optimum magnetic properties.